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BOOK REVIEWS

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In response to the interest expressed by many members of TIMS, we propose to begin listing working papers by title and author at the end of the Book Reviews Section. Any interested author of a working paper should send a copy of it to the Book Reviews editor. Any working paper which is received by the editor will be listed without comment. It is hoped that this will provide better communication of the kind of work which is in progress and will permit direct contact among various persons who may be pursuing similar directions in their research.

Some Books on Model Building

SAATY, THOMAS L., *Mathematical Models of Arms Control and Disarmament*. New York: John Wiley & Sons, Inc., 1968, 190 pp., \$10.95.

This fascinating book is an important contribution to the pressing task of discovering some valid underlying mathematical structures in politics. Dr. Saaty is currently "responsible for basic research" in the Science and Technology Bureau of the United States Arms Control and Disarmament Agency. This book is a major first effort at bringing quantitative methods to bear on the urgent problems of arms control. In it the author has utilized a variety of mathematical methods and models in order to provide some guidance through the tangled skein of arguments surrounding the questions of arms control and disarmament.

Dr. Saaty begins with a statement of the framework of arms control and a discussion of consistency of objectives. He presents an interesting example due to Joxe which is based on five political objectives of West Germany and uses elementary logic to analyze the consistency of the objectives as they come under the influence of other countries' objectives. An excellent chapter is devoted to models of arms races in terms of equilibrium and stability. There is a nice example of the effect of multiple warheads on the region of stability; a remarkably simple model dealing with the stability of deterrence; an interesting use of graph theory in analyzing arms reduction, with a neat use of matrices to deal with the well-known problem of missionaries and cannibals crossing a river; a discussion of Richardson's model of arms build-up; and a statement of Intriligator's analysis of strategy in a missile war, using the mathematical theory of optimum control.

Two chapters are devoted to the use of game theory, with the author stating that "Its present contributions must be regarded primarily in terms of the conceptualization and structuring it provides to the possible treatment of such problems." Dr. Saaty gives an excellent comprehensive chart which shows the ramifications of optimization theory, within which he includes game theory, and another good chart which shows the important problem areas of decision theory. After a good summary of two-person game theory, including Nash's solutions to nonzero-sum games, Howard's theory of meta-games is discussed and then applied to the problem of nuclear proliferation as it affects West Germany and to the requirements for a stable settlement in Vietnam. A chapter is devoted to the application of the theory of games with incomplete information to arms control and with the game theoretic approach to the notion of the balance of power. The analysis of games with incomplete information is particularly interesting. As the author states: "We have now learned that any attempt to make use of information not available to a wise opponent results in partially revealing this information to him." Further, it may be the case that it will be advantageous to a country *not* to give to its negotiator all of the available information. Further, the argument "emphatically shows that putting all cards on the table may be a great disadvantage."

A chapter is devoted to some particularly simple, and instructive, models of violation of arms control and inspection phenomena: a confidence model; a simple prior-free model leading to the negative binomial distribution; a Bayesian model; a decision theoretic model based on the complexity of the signal received at a recording instrument; a model showing that poor inspectors may be preferred to highly reliable black boxes; and a nice game-theoretic model dealing with one country which hopes to conduct clandestine tests while the other country has a fixed number of inspections available and leading to an inductive determination of the value of the game which is much like that used to solve the pitcher-batter duel in baseball. There is a final, excellent chapter on "Some Research on Conflicts" which includes some discussion of the data relating aggression to political stability, due to the Feierabend.

This very fine book is highly recommended both because of its numerous fascinating models and because of the deadly importance of its subject.

CHORLEY, RICHARD J. AND PETER HAGGETT (eds.), *Socio-Economic Models in Geography*. New York: Barnes & Noble, Inc., 1968, 300 pp., paperback \$3.50.

This extremely interesting book is a paperback edition of seven chapters selected from an earlier hardback edition with a slightly different title (*Models in Geography*; London, Methuen, 1967). One does not need to be a geographer in order to profit from this book. Indeed, it will demonstrate that there is an extremely large literature dealing with model building in geography and that those of us who had our last thought about geography in the eighth grade need to mend our ways.

Professors Haggett and Chorley give an excellent, highly compressed summary of the nature of models and paradigms, including a discussion of Berry's conceptualization of geography as manipulations of the "geographical data-matrix" and some interesting comments on the information explosion of the data matrix. Professor Wrigley discusses "Demographic Models and Geography" with some important and timely analyses of the interrelationships among subsistence level, fertility, and mortality rates as a function of population size. I found Professor Pahl's "Sociological Models in Geography" less interesting because there is too little direct discussion of the use of sociological models in geography and too much discussion of the need to use such models.

On the other hand, Professor Keeble's "Models of Economic Development" could be taken as a model of this kind of survey. He develops a typology of economic growth models: nonspatial and spatial; supranational, national, and subnational. Using this structure he proceeds to give a masterful survey of the large literature on the subject. Among others, he discusses Rostow's five-stage model at some length and Myrdal's model based on "cumulative causation"—and finds space for lots of less well-known models such as Smith's use of Markov-chain models of differential regional economic growth.

Professor Garner gives a superb exposition of "Models of Urban Geography and Settlement Location" in which he provides excellent summaries of the basic original work of Christaller and Losch and an interesting discussion of the rank-size regularities made famous by Zipf. His material on the internal structures of cities is particularly interesting and includes some of the evidence for the negative exponential decline of population density with distance from the city center. Professor Hamilton's chapter on "Models of Industrial Location" is also top-notch. He starts with a review of Launhardt's very early analyses and discusses Alfred Weber's theory at some length. He brings his survey right up to date and contrasts methods of location under socialist systems with those under capitalism. There is a section on Monte-Carlo and Markov-chain models. Finally, Professor Henshall has a good chapter on "Models of Agricultural Activity" which has some interesting discussion of taxonomic models of agricultural systems and the indices which have been proposed as a basis for classification.

It should be noted that the bibliographies appended to each chapter are unusually comprehensive. This is an excellent book and it can be highly recommended to any model-builder and to any quantitative analyst who wants some examples of hard thinking in a complex area.

BOCK, R. DARRELL AND LYLE V. JONES, *The Measurement and Prediction of Judgment and Choice*. San Francisco, Calif.: Holden-Day, Inc., 1968, 370 pp., \$14.50.

This book is devoted to the problem of predicting choices when the alternatives are fixed in advance. Both predictions for given subjects and for subject populations are considered. The procedure followed requires the estimation of parameters which characterize the subject, or population, with respect to specific stimuli. The process of parameter estimation depends on the experimental procedure, the model relating the data to the parameters, and the statistical estimation methods. This book follows psychophysical practice by using the experimental procedures as the primary classification. Within each procedure, alternative models are discussed, and for each model alternative estimation methods are considered.

The four experimental procedures considered are the constant method, the method of paired comparisons, the ranking method, and the rating-scale method. The analysis is based on the models for comparative judgment and categorical judgment proposed by Thurstone. The authors try to show that the four experimental procedures provide independent methods of measuring the same quantities since Thurstonian models with a common set of parameters can be formulated for each. Estimation procedures used are a modified kind of least squares estimation, sometimes called the Neyman linearization technique, and maximum likelihood.

There are 41 pages of relevant tables. Lots of examples are given to illustrate the procedures. This is by no means an easy book and the reader needs good calculus and

matrix theory. There is probably a good deal more detail here than will be desired by most readers of our journal but the book will be of interest to some readers for at least two reasons. First, it is replete with carefully formulated models for which estimation procedures are worked out and illustrated. Second, although this book assumes the existence of an underlying sensory continuum, the analysis is formally equivalent if a hedonic continuum is assumed, as in food research, or utility, as in decision theory.

LOED, FREDERIC M. AND MELVIN R. NOVIC, *Statistical Theories of Mental Test Scores*; with contributions by Allan Birnbaum. Reading, Mass.: Addison-Wesley Publishing Co., 1968, 568 pp., \$14.95.

The models which are used in psychometrics to represent the relationship between a criterion measure and the probability of a favorable response to a test question are formally identical with the psychophysical models used in the book of the preceding review. Therefore, in this sense there is a common methodology for psychophysical and psychometric studies of behavior. This book can, therefore, be read in conjunction with that of Professors Bock and Jones, reviewed above.

The present book deals with models of the relationships that exist among true test scores, observed test scores, and error scores (true score minus observed score). Part 2 deals with the classical test theory model: true score is defined as the expected value of the observed scores of a given person over a sequence of statistically independent measurements; error scores are uncorrelated with true scores; and error scores on different measurements are uncorrelated. Questions of validity, reliability, composite tests, test length as a parameter, measurement precision, estimation, and prediction are considered. Classical test theory is a model based on relatively weak assumptions. Such models are called weak true-score models.

Part 3 deals with some other weak true-score models. Three basic models are discussed. One is based on the definition of true score as generic true score. To illustrate the difference, a professor might define true score for a particular student in a particular course as the expected score the student would have achieved in a (hypothetical) long sequence of independent trials on the same final examination. This would be the classical theory. Alternatively, he might define the true score as the student's expected score on all the final examinations the professor might write. This would be the generic true score. Another model is a variation of this one but assuming, to stick with our example, that the true scores of the different tests may differ by different amounts for different students. It turns out that in theory this model permits the estimation of the higher-order moments of the true-score distribution and of the error-score distribution. The third model deals with cases where the test score for an individual is the sum of n item scores and where the n test items are considered to be a random sample from a population of items.

Part 4 deals with validity and test construction theory. A chapter on "The Selection of Predictor Variables" discusses a problem which is quite analogical to the selection of the best subset of advertising media.

Chapter 16 deals with "Latent Traits and Item Characteristic Functions." If a psychologist, for example, wants to use the responses on a mental test to infer something about the responder's psychological traits, then he must have some model suggesting how the responses are related to the traits. A major general model of this kind is the latent trait model, which is very similar to Lazarsfeld's latent structure analysis. The

normal ogive model of latent traits is discussed at some length. Chapters 17-20, written by Professor Birnbaum, deal with logistic models of latent traits and their relation to tests and theories.

Part VI is devoted to strong true-score theory, which means that fairly demanding assumptions are made. Chapter 21 presents two Poisson process models due to Rasch. Each model has two parameters, one for the ability of the person and the other for the difficulty of the measurement. The two parameters can be estimated independently. Chapter 22 deals with "Measurements With Independent Errors of Known Distributional Form." From the basic relation, true score equals observed score plus error score, it follows that the probability density function of the true scores is the convolution of those of observed score and error score. Hence, if the distribution of errors is assumed known it follows that the moments, at least, of the true-score distribution can be deduced from those of the observed scores. Chapter 23 develops another model based on the assumption that the conditional distribution of observed score for a given true score is a compound binomial distribution. This model is applicable when the total score on a test is simply the number of items answered correctly. With this model it is shown that if the true score has a linear regression on observed score then the observed score has a negative hypergeometric distribution.

The exposition is good throughout the book. The mathematical demands vary considerably but good calculus and good statistics should be sufficient for most of the book. This book is an excellent example of the application of a variety of different models to explain the same phenomenon. The implications of the models are carefully explored and the problems are clearly delineated. There are of course, many other phenomena with a structure similar to the basic one investigated here and the methods developed in this book can be usefully applied elsewhere as well. But in any case, persons who are interested in the problems of model building will find the book interesting.

RUSSETT, BRUCE M. (ed.), *Economic Theories of International Politics*. Chicago, Ill.: Markham Publishing Co., 1968, 542 pp., \$7.95.

This is a good selection of papers which is intended "to illustrate some potential applications of economic theories and analytical techniques to major problems of international politics at a variety of levels."

Part I has 7 papers dealing with "Alliances and the Collective Pursuit of Benefits." One of the basic questions here has to do with private and public (or collective) goods and benefits. For example, Olson and Zeckhauser, in "An Economic Theory of Alliances," conclude that "a decline in the amity, unity, and community of interest among allies need not necessarily reduce the effectiveness of an alliance, because the decline in these alliance 'virtues' produces a greater ratio of private to collective benefits." There is a very interesting paper by Buchanan, "An Economic Theory of Clubs," in which he considers "goods and services, the consumption of which involves some 'publicness', where the optimal sharing group is more than one person" but not the entire public. Thus, he is dealing with the practically important cases where goods are neither purely private nor purely public. A paper by Cross, "Some Theoretic Characteristics of Economic and Political Coalitions," bases his analysis of the formation of coalitions on the premise that alliance members want to maximize the value to themselves of their membership and that membership in one grouping precludes membership in another.

Part II has 12 papers on "Markets and International Systems." The relevance of many of these papers depends, again, on the question of collective goods—with stability or the avoidance of war being the most important such collective good. This is the basis for the inclusion of such papers as Olson's "A Theory of Groups and Organizations" and Stigler's "A Theory of Oligopoly."

Part III has 6 papers on "Internal Determinants of National Behavior." Included is the paper by Monsen and Downs, "A Theory of Large Managerial Firms," which draws some of the implications from the probable fact that the objectives of the managers of firms are not the same as those of the owners of the firm. The intended analogy is that of national leaders as managers and the maximization of national power as the maximization of profit.

Part IV has 4 papers on "Alternative Organizations for International Decision Making." A selection by Buchanan and Tullock, "The Costs of Decision Making," suggests, following the editor, that it may be undesirable, even if possible, to transfer decision making from nation-states to a supranational organization. Also included is an excellent paper by Kahn, "The Tyranny of Small Decisions: Market Failures, Imperfections, and the Limits of Econometrics," which argues for the necessity of a comprehensive over-all plan lest one is brought, by a series of small decisions, to an unwanted and unforeseen, but irreversible, outcome.

The papers in this collection are generally interesting and the editor's comments point the way to their application in international politics. The book can be recommended as a good example of the use of the concepts and methods of one discipline, here economics, to achieve insights in another, here international politics.

Two Books on Operations Research

CONWAY, RICHARD W., WILLIAM L. MAXWELL, AND LOUIS W. MILLER, *Theory of scheduling*. Reading, Mass.: Addison-Wesley Publishing Co., Inc., 1967, 294 pp., \$12.50.

This excellent book is an attempt to organize and present the body of work which has been done on scheduling problems. The organization is according to type of problem rather than technique of solution. As the authors point out, "there are basically three types of attack on scheduling problems: algebraic, probabilistic, and Monte Carlo simulation by computer."

In the first chapter the authors define sequencing problems; distinguish static problems ("a number of jobs arrive simultaneously in a shop that is idle and immediately available for work") and dynamic problems (the shop is a continuous process and jobs arrive intermittently); and introduce a convenient notation of the form $A/B/C/D$, where A describes the job-arrival process, B gives the number of machines in the shop, C describes the flow pattern in the shop, and D describes the criterion by which the schedule is to be evaluated. It should be noted that a crucial distinction is that between a job-shop and a flow-shop. In a flow-shop all jobs follow the same path from one machine to another. In a job-shop the jobs can each follow a completely different required sequence of operations by the machines. In this notation Johnson's well-known problem is $n/2/F/F_{\max}$: sequence an arbitrary number of jobs in a two-machine flow-shop so as to minimize the maximum flow-time.

Chapter 2 is devoted to "Measures for Schedule Evaluation." Chapters 3-7 deal with static problems, Chapter 3 treats "Finite Sequencing for a Single Machine": n jobs arrive simultaneously at a single machine which has no other obligations and set-

up time is independent of sequence. There are quite a few interesting theorems and results for this simplest of all sequencing problems. Chapter 4 deals with problems of n jobs and a single machine which violate one or another of the assumptions of Chapter 3: set-up time depends on the sequence, jobs do not arrive simultaneously, or jobs have required precedence relationships. When the set-up time depends on the sequence it is obviously necessary to work with a matrix showing the set-up times required to change over from job i to job j . Maximum flow-time is minimized by minimizing the sum of the set-up times and this, of course, is essentially the traveling-salesman problem. The authors describe a branch-and-bound algorithm for this problem and a dynamic programming procedure. These will obtain optimal solutions for problems of modest size and approximate solutions to larger problems.

Chapter 5 deals with flow-shop scheduling with two or more machines. The importance of the criterion is evident here. Johnson's algorithm produces the optimal schedule for a two-machine flow-shop if the objective is to minimize the maximum flow-time. However, no equivalent algorithm is available if the objective is to minimize the mean flow-time, although the authors describe a branch-and-bound procedure. The $n/3/F/F_{\max}$ problem cannot be solved in practice although special cases can be solved by Johnson's algorithm, a branch-and-bound technique is available, and an integer programming solution is theoretically available.

Chapter 6 treats the general job-shop problem: n jobs and m machines. An integer-programming formulation of this job-shop problem is available but it is not feasible for realistic problems. With only 4 machines and 10 jobs there are 220 variables and 390 restricting equations. The authors discuss a number of heuristic approaches to this problem. Chapter 7 discusses the relationship between general network problems and scheduling problems. Using graph theory, the authors discuss critical route analysis, shortest-route determination, and briefly, assembly-line balancing problems.

Chapters 8-11 deal with dynamic problems. Such problems can be studied as queuing systems with emphasis on the selection discipline. Chapter 8 deals with "Selection Disciplines in a Single-server Queuing System." Disciplines that are analyzed include first-come, first-served; last-come, first-served; random; nonpreemptive priority; shortest-processing-time; preemptive-resume; preemptive-repeat; and due-date rules. Chapter 9 continues the analysis of single-server queuing systems by separating the set-up and processing times and by making some realistic assumptions about set-up time. For example, a reasonable model might require that set-up time would have to be repeated if preemption occurred. As the authors state: "The analysis becomes much more difficult and the results are very modest." However, they "certainly suggest areas in which further work could be done."

Chapter 10 treats "Multiple-server Queuing Models," which visualize job-shops and flow-shops as queuing networks. The authors warn us that "In fact, a harsh critic could conclude that there are no network queuing results." And they add, "However, any time the machines behave in a truly interrelated manner there are virtually no applicable theoretical results." The major results provide means for "identifying the special conditions under which the individual machines are essentially independent and their individual queues can be analyzed separately." Chapter 11 is devoted to the use of simulation in the investigation of various possible scheduling procedures. All of the results reported involved simulation of a dynamic job-shop process. It should be noted that there are some computational difficulties here since, for example, "In one study an IBM 7090 processed only 300 to 700 jobs per minute, depending on the complexity of the scheduling procedure, in a SIMSCRIPT model of a nine-machine shop." Some of the examples are particularly interesting instances of the use of simulation to

investigate differences in measures of performance. Most of the examples involve the use of simulation to analyze more complex systems and more realistic assumptions than the theoretical analyses can handle.

This book is a notable contribution to the operations-research literature. The authors have performed a signal service to the profession by organizing and skillfully expositing the widely scattered results in the theory of scheduling. Not the least of the many merits of this book is the fact that it delineates so clearly the work that remains to be done. In the static problem area there are unsolved problems which are more easily understandable than those in almost any other area of management science. Of course, the authors give warning about the general job-shop problem: "Although it is easy to state, and to visualize what is required, it is extremely difficult to make any progress whatever toward a solution. Many proficient people have considered the problem, and all have come away essentially empty-handed." Still, who can resist the challenge?

It goes without saying that this top-notch book is essential to anyone who ever has to deal with a scheduling problem. But I recommend it strongly to quantitative analysis in general, both for the interest of the results already achieved and because of the intriguing problems that remain.

BEGED DOV, AHARON G. (ed.), *Managerial Applications of Quantitative Analysis*. Toledo, Ohio: University of Toledo, 1968, 226 pp., \$3.98.

This book has some merit but not enough to justify using it as a precedent. It is a collection of 17 papers prepared by MBA students under the supervision of Professor Beged Dov at the College of Business Administration of the University of Toledo. The papers are mostly of about the quality one expects from reasonably good MBA candidates who have been well motivated. Why, then, should I not similarly have published each year's crop of OR papers by my students? And why should not each professor do likewise? Why not, indeed! The resulting tidal wave of books would sweep us all to early graves. So, for self protection we resist any such temptation even though our students would undoubtedly applaud an analogous preservation of their efforts as in the best interests of posterity. For this reason I cannot recommend this book as an example for others to follow.

This granted, some of the papers are interesting attempts to deal with new problems. Thus, Messrs. Flack, Hanlon, and Kuhlman analyze the question of whether to purchase automobile fleet collision insurance or whether to self-insure. Professor Beged Dov and Mr. Gregory have an interesting analysis of the effect of operator learning rate on shrinkage allowance. There are papers on optimal maintenance crew size, build or lease decisions, a programming approach to the optimal utilization of academic facilities, and so forth. Most of the papers give clear signs of having been written by MBA candidates so I guess I cannot recommend the book. However, personally, I would have bought the book simply for the interesting self-insurance example.

Some Books on Mathematics

BELLMAN, RICHARD, *Introduction to the Mathematical Theory of Control Processes*. New York: Academic Press, Inc., 1967, 245 pp., \$11.50.

This remarkably fine book is intended to be the first of three volumes on the mathematical theory of control processes. This first volume deals with deterministic control

processes which can be formulated in terms of quadratic functional and linear differential equations. The second volume will treat deterministic problems with more general functionals and nonlinear differential equations. The third volume will deal with stochastic control processes.

The present book is intended for students with good calculus, differential equations, and some matrix theory. It is difficult to imagine a more felicitous presentation of this material. A short introductory chapter describes control theory. The second chapter gives the necessary material on second-order linear differential and difference equations. The third chapter uses a simple pendulum model to provide a crystal-clear statement of the ideas of stability and control. Chapters 4 and 5 deal with the scalar case. Chapter 4 uses calculus of variations to treat continuous variational processes and Chapter 5 uses dynamic programming for the same problem and also for discrete control processes. Chapter 6 reviews the applications of matrix theory to multidimensional linear differential equations. Chapters 7 and 8 then generalize, respectively, Chapters 4 and 5 to multidimensional optimization problems, with some discussion of the numerical problems in these cases. Chapter 9 uses functional analysis in a reconsideration of the problems of the earlier chapters. This last chapter assumes some minimal knowledge of Hilbert space theory. There are numerous problems, including many fairly difficult ones.

The exposition is of almost unequalled clarity. I can recall only a handful of mathematical books which have achieved such transparency in their presentation. How does Professor Bellman accomplish this? I do not know but I notice at least three contributing factors. First, in the author's words: "We try as carefully as we can to avoid a confusion of purely analytic difficulties due to the nature of the equation with conceptual complexities inherent in a theory of control." Second, the organization of the material is in terms of the logic of the problem, not the logic of the mathematical apparatus. Third, the style of writing is very pleasant and creates the illusion that the reader is in complicity with the author in surmounting the difficulties en route. These factors support, but do not suffice to explain, the excellence of this book. Highly recommended to anyone who wants to know something about control theory.

FIKE, C. T., *Computer Evaluation of Mathematical Functions*. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1968, 227 pp., \$10.50.

This excellent book is the best introduction to the theory and practice of the approximation of functions that I am familiar with. After a good chapter on errors in function evaluation computations, Mr. Fike devotes a chapter to methods used for range reduction and another chapter to economical methods for polynomial evaluation. Three chapters cover polynomial approximations: the first deals with minimax approximation and includes Remez's method for determining them; the second covers Chebyshev polynomials; the third discusses various methods such as the truncation of power series and economization. Three chapters are devoted to rational approximations: the first deals with methods for evaluating rational functions; the second covers minimax rational approximations and gives Remez's method for determining them; the third discusses various rational approximation methods such as Pade approximations, Maehly's method, truncation of continued fraction expansions, and economization of continued fractions. A final chapter discusses asymptotic expansions.

The presentation is remarkably clear and easy to follow. There are lots of examples

and numerous references to the literature. Problems are included. This is a very fine book and can be highly recommended for consideration as a text and also for self study by those who want to learn something about this attractive subject.

KUNZI, HANS P., H. G. TZSCHACH, AND C. A. ZEHNDER, *Numerical Methods of Mathematical Optimization With ALGOL and FORTRAN Programs*. New York: Academic Press, Inc., 1968, 171 pp., \$10.50.

This book is a translation from the German edition published in 1967. The book has four chapters. Chapter 1 is on linear optimization and gives the underlying theory of linear programming, including the simplex method, the inverse simplex method, Dantzig and Wolfe's decomposition algorithm, the duoplex algorithm of Kunzi, and Gomory's algorithm for integer programming. Chapter 2 is on nonlinear optimization and covers the Kuhn-Tucker conditions and quadratic optimization by the methods of Beale and Wolfe and a brief discussion of some more general methods. Chapter 3 gives some explanation of the computer programs given in Chapter 4: ALGOL and FORTRAN programs for each of the specific algorithms and methods mentioned above. The presentation is clear and straightforward throughout. This book can be recommended as a convenient short statement of some of the theory of optimization and also as a quick source for the necessary computer programs.

Two Statistics Books

BRAMBILLA, FRANCESCO, *Trattato di Statistica. I: La Variabilità*. Torino, Italy: Unione Tipografico-Editrice Torinese, 1968, 1376 pp., 20,000 L.

This book is as remarkable as it is huge. It is Volume I in a projected five-volume work on statistics and operations research. The present volume is on variability. A unique cross-section of statistics has been achieved by taking this as the theme of this book.

Unfortunately, there are exceptional difficulties in reviewing this book. There are three main reasons for this. First, the arrangement and coverage of the book is really quite unique. Second, the book is enormous: 2 volumes 7, parts, and 51 chapters. Third, it is in Italian so it will not be accessible to most of the readers of this journal. These reasons interact to produce the following situation: a review of considerable length is needed even to outline the structure of the book but a lengthy review cannot be justified in terms of the potential usefulness of the book to our readers.

Still, the extraordinarily high quality of the book demands some attempt to convey its merits. I shall try to compromise by a combination of some unsupported general statements and a reliance on sampling. First, the general style of the book is excellent. It is a practitioner's book, with little theory for the sake of theory but with clear statements of the assumptions underlying the approaches and methods discussed. The mathematical level is just right: good advanced calculus is needed but the book is quite a bit easier, say, than Kendall and Stuart. Second, if the relative amount of unfamiliar material presented is an index of merit—and I think it is—then this book must be given a very high rating. Since Italian statisticians have always been leaders

in developing descriptive statistical measures one is not surprised to find discussions of Gini's mean difference and index of concentration and his index of cograduation or indices of concentration proposed by Bonferroni, de Vergottini, Giaccardi and so forth. But one has less reason to expect discussions of D'Addario's transformations, Johnson's system of transformations, Medgyessy's method of decomposition of mixed distributions, Darmois's method of statistical estimation, the principle of maximizing entropy, and numerous other specific results and procedures which are not readily available in any English statistical books. Third, the coverage is very large, as would be suggested by the book's size. There are chapters on spectral analysis, stationary stochastic processes, stochastic convergence, sequential analysis, discriminatory analysis, latent structure, canonical correlation, and so forth.

All in all, Professor Brambilla has given us an outstanding book on statistics. If it were in English it would be very much in demand among practicing statisticians. And it may even be enough to lead us to practice our Italian.

KRAFT, CHARLES H. AND CONSTANCE VAN EEDEN, *A Nonparametric Introduction to Statistics*. New York: The Macmillan Co., 1968, 342 pp., \$9.95.

Surely one of the more difficult tasks in text-book writing is to produce an introductory text in statistics which is simultaneously original, theoretically sound, and teachable. In this book Professor Kraft and van Eeden have accomplished this feat. The authors state in their preface: "We chose nonparametric methods as the principal vehicle for this introduction because of the simplicity of their basic probability theory. This simplicity permits an introduction to inference, that is, to the establishment of a relationship between observations and a family of models, to precede a discussion of probability."

The authors begin by describing the structure of a simple treatment and control experiment. They proceed to a clear statement of the meaning of models for the effect of treatment and to the definition of the class of additive models. Then a chapter presents the basic procedure for relating the observations to the class of models. This is based on an ordering of the possible ways in which the total number of measurements, control plus treatment, can be divided into two groups. Three major ways of ordering are then considered: the absolute value of the difference between the means, the absolute value of the difference between the average values of the ranks, and a test based on the numbers of measurements above and below the median of the set of all measurements. A good chapter is devoted to randomisation and another to "Basing Decisions on Experiments." The basic properties (mean and standard deviation) of populations are discussed and some particular populations (binomial, hypergeometric, and normal) are described.

Part II is devoted to descriptions of specific analyses: Wilcoxon, Mann-Whitney, Fisher-Pitman, Kruskal-Wallis, Rijkooort, Mood-Brown, Kolmogorov-Smirnov, Chi-squared, and rank correlation tests of independence. There are 138 pages of tables which make the book self-contained with regard to the indicated analyses. There are quite a few problems and partial answers are given.

The exposition is admirably clear and straightforward. This is an excellent book and surely ought to be considered as a text in an introductory course in statistics despite the fact that a number of traditional topics of statistics courses are not included.

Some Books on Economics

THEIL, HENRI, *Economics and Information Theory*. Chicago, Ill.: Rand McNally & Co., 1967, 488 pp., \$16.

This book certainly is about an interesting subject: How can information theory be used in economics? Professor Theil gives his answer to this question in this book. His basic conception stems from the idea of economics as the subject which is concerned with the allocation of scarce means among ends. This granted, then the share of each resource which is allocated to each end is a nonnegative number between zero and one which can be interpreted, formally, as a probability. Hence, the concepts of information theory can be directly applied to these shares. As the author says, information theory "is actually a general partitioning theory in the sense that it presents measures for the way in which some set is divided into subsets."

The first three chapters give an easy introduction to the concepts of information theory which the author uses. They also present the specific way in which Professor Theil applies information theory to forecasts. He defines the information content of a forecast, the information inaccuracy of a forecast, and the information gain of a forecast all basically in terms of the idea that if the occurrence of an event after a forecast carries a lot of information then the forecast was a poor one. In Chapter 4 the author discusses the use of redundancy as a measure of income inequality, which he suggests is a better measure than some other proposals, such as Gini's concentration ratio. Chapter 5 is devoted to the use of information theory in the index number problem. Having defined an index number which is # 123 on Irving Fisher's list (*The Making of Index Numbers*; Boston, Houghton Mifflin Co., 1922; p. 473), the author shows that the index does not satisfy the factor reversal test. However, the divergence from the desired equality in the factor reversal test (called the allocation discrepancy) is related directly to two measures of conditional information content.

Chapter 6 is a theoretical discussion of consumer demand. Chapter 7 is an attempt "to analyze the empirical implications of the demand model of Chapter 6 by means of some of the data of Chapter 5." In Chapters 8-10 the author extends his analysis to problems of the firm and of international trade. As for the distribution of income, redundancy is suggested as a measure of industrial concentration. An informational criterion of input heterogeneity of industries is suggested as a measure of the error committed in collapsing an input-output table.

The exposition is generally clear. A fair amount of mathematics is needed to follow the argument: good calculus, matrix algebra, and some mathematical economics. This book will be primarily of interest to economists but the general arguments used in applying information theory will be of more general interest.

SANDRETTO, PETER C., *The Economic Management of Research and Engineering*. New York: John Wiley & Sons, Inc., 1968, 199 pp., \$9.50.

This interesting book is intended for managers of technical efforts, "from the most esoteric research to the most mundane engineering." Mr. Sandretto begins by showing how the total technical effort should be analyzed as to cost and allocation. A chapter discusses ways of determining an annual research budget and argues that it is important to make separate determinations of how much should be spent and how much can be

afforded. A chapter deals with methods for selecting profitable projects and includes a discussion of a research evaluation formula due to Dr. Rader as well as some of the usual methods.

There is a chapter on the importance of the project plan and another on the control of engineering projects by PERT and other procedures. The author emphasizes and illustrates that "Because of the difficulties of measuring performance and of the concern with cost and the ease of determining it, management must bear in mind that technical performance, not cost, is the datum point of reference." A good chapter is devoted to "Executive Action" and describes seven parameters that may be used in evaluating development efforts.

Lots of good examples are given and there is some interesting data, such as the time variances on the completion of 44 projects in electronics. This was intended to be "a practical guide to the subject" and it certainly succeeds. This book can be recommended to managers of OR groups who may find some ideas for approaches to their managerial problems.

CLARKSON, G. P. E. (ed.), *Managerial Economics*. Baltimore, Md.: Penguin Books Inc., 1968, 429 pp., paperback \$1.95.

This is a good, inexpensive selection of readings relevant to managerial economics. "Relevant" means that the readings are based on the editor's belief that operations research methods fall within the field of managerial economics. The book could equally well have been called "Management Science" or some such.

Professor Clarkson has arranged his 11 selections in five Parts: Economic Theory and Business Behavior; Some Managerial Decision Models; Financial Decision-Making Production and Inventory Systems; Mathematical Programming. The selections are good ones and they are not hackneyed by frequent reprinting. Thus, included are: Simon's "Theory of Decision-Making in Economics and Behavioral Sciences"; Ansoff's "A Model for Diversification"; Cyert, Davidson, and Thompson's "Estimation of the Allowance for Doubtful Accounts by Markov Chains"; Howard's "Dynamic Programming"; and other interesting articles. Recommended.

Two Miscellaneous Books

RESCHER, NICHOLAS (ed.), *The Logic of Decision and Action*. Pittsburgh, Pa.: University of Pittsburgh Press, 1967, 226 pp., \$7.50.

The title of this book, and the fact that one of the papers was by Professor Simon, led me to think that it might be of general interest to readers of this journal. In fact, it is not. All of the papers except one deal with intricate questions in modern logic of imperatives, deontic logic, and the logic of preference.

The exception is the paper of Professor Simon, "The Logic of Heuristic Decision Making". He argues here, as in an earlier paper, that there is no need for a special logic of imperatives or a deontic logic and that practitioners get along very well without them. He says: "My claim is not that declarative logic cum conversion rules is adequate for economists and engineers, but that it is adequate for logicians." That he

should take this position at the conference at which these other papers were given strikes me as highly amusing and I enjoyed the incisive comeuppance he gave to one of the commentators on his paper. Unfortunately, the rest of the papers are something else.

LEGMAN, G., *Rationale of the Dirty Joke; An Analysis of Sexual Humor*; First Series. New York: Grove Press, 1968, 811 pp., \$15.

Gershon Legman is the world's greatest authority on erotica. He is a unique combination of scholar's scholar and champion of truth on the side of humanity in the public arenas. The major battles he wages are never-ending struggles which we are all perilously near losing. Perhaps the most important one is that of sadism against sex. Mr. Legman maintains that the true perversions and obscenities are those of sadism; that our society prefers sadism to sex; that sex is not only better—it is more fun. This is one of the strands the author uses in weaving his analysis of dirty jokes in this remarkable book, the first of two on the subject.

In the text the huge number of dirty jokes are given in italics. As the author says: "That is to say, perfectly frankly, that the editor has been given to understand that there are many people who will confine themselves strictly to the italic jokes, and will skip all the laborious discussion . . . I only hope that there will be no one so unutterably stuffy as to read only the discussion—of such a subject as this—and to skip all the jokes." In fact, it would be folly not to read either. Almost anyone will break up over at least a hundred or so of these jokes. Further, following up some of the author's comments, some interesting introspective insights are to be obtained by noting the kinds of jokes which one finds funny. And the analysis of the jokes is inimitable: effortless erudition and a coruscating display of intellectual fireworks which may possibly leave the reader shell-shocked but will surely leave him wiser. This book is definitely not for the squeamish or the prudish but if you are otherwise, don't miss it!

All unsigned reviews are written by the Book Reviews editor.